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The PA (Personality and Activity) Project

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THE PA (PERSONALITY AND ACTIVITY) PROJECT

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ABSTRACT

Background: We have a limited understanding of the interrelationships between personality, the concurrent engagement in individual and clustering of health-enhancing behaviors, and executive function (EF), particularly within the context of the Transtheoretical model (TTM). The aims of this thesis were to examine 1) the link between personality and several health behaviors, 2) whether EF moderates the relationship between personality and physical activity, and 3) whether personality moderates the relationship between TTM and physical activity. **Methods:** Recruitment of individuals included 200 undergraduate and graduate students from a university in the South of the United States for baseline assessments. Among these 200 participants, 126 provided complete data for the 5-month follow-up assessment. **Results:** With regard to Aim 1, the personality traits extraversion, conscientiousness, openness to experience, and agreeableness were prospectively associated with select health behaviors. Regarding Aim 2, there was no evidence of an interaction effect for personality traits and EF on 5-month follow-up PA. Regarding Aim 3, the only TTM construct associated with follow-up moderate-to-vigorous physical activity (MVPA) was behavioral processes of change ($\beta = 10.0$; 95% CI: -0.34, 20.37; P=0.05). There were no significant interaction effects for any of the TTM constructs and personality types on follow-up MVPA. **Conclusion:** Personality traits are associated with health behaviors, including physical activity (Aim 1). Therefore, personality is important to consider when promoting health behaviors among individuals. However, there was no evidence to suggest that EF moderates the role between personality and physical activity (Aim 2), and similarly,

personality did not moderate the relationship between TTM and PA (Aim 3). These findings suggest an important role of personality on physical activity (and other health behaviors). Additionally, if confirmed by future research, these findings also suggest that TTM-based physical activity interventions may not need to develop personality-matched TTM strategies, and similarly, personality-tailored PA interventions may not need to develop EF-matched strategies.

LIST OF ABBREVIATIONS

Behavioral process of change (BPC)

Cognitive process of change (CPC)

Executive function (EF)

Moderate-to-vigorous physical activity (MVPA)

National Health and Nutrition Examination Survey (NHANES)

Neuroticism-Extraversion-Openness Five Factor Inventory (NEO-FFI)

Parametric Go/No-Go (PGNG)

Pittsburgh Sleep Quality Index questionnaire (PSQI)

Starting the Conversation (STC)

Transtheoretical model (TTM)

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I. METHODOLOGICAL APPROACH

Design and Participants

The study design was a prospective study. Recruitment of individuals included 200 undergraduate and graduate students from a university in the South of the United States for baseline assessments. Participants were recruited via a convenience-based sampling approach. When participants arrived at the laboratory, they were asked to complete an informed consent. Then, participants completed surveys assessing personality, health behaviors, and TTM constructs. All baselines parameters were assessed via paper-and-pencil surveys. In addition to the paper surveys, participants also completed a computerized Parametric Go/No-Go (PGNG) task (only completed at baseline). Baseline assessments occurred between October 2015 and June 2016. After approximately five months from the participant's baseline visit, all participants were reassessed. To minimize potential common method bias among the evaluated parameters,[18] baseline assessments (with the exception of measured body mass index) occurred in our laboratory via a paper-and-pencil survey, whereas the follow-up participants completed the survey via an on-line portal (Qualtrics) that was sent to them via e-mail. Participants did not complete a follow-up PGNG task.

Among the 200 participants who were recruited, all 200 participants provided complete baseline data on the study variables (no missing values). Among these 200 participants, 126 provided complete data for the 5-month follow-up assessment (63% response rate), with these

126 participants constituting our analytic sample. When comparing (baseline estimates) the analyzed sample (N=126) to the sample lost to follow-up (N=74), there were no differences in gender (61.9% vs. 65.2%; P=0.61), age (21.6 yrs vs. 21.5 yrs; P=0.72), ethnicity (66% white vs. 75% white; P=0.62), education (81% undergraduate vs. 93% undergraduate; P=0.07), perceived health status (16.6% excellent vs. 13.9% excellent; P=0.50), neuroticism (30.9 vs. 30.4; P=0.64), extraversion (43.3 vs. 42.9; P=0.71), openness (39.0 vs; 38.9; P=0.95), agreeableness (45.7 vs. 45.2; P=0.59), conscientiousness (46.9 vs; 46.5; P=0.75), hours of sleep per night (6.7 hrs vs. 6.8 hrs; P=0.86), or dietary score (17.9 vs. 17.7; P=0.62). However, those lost to follow-up were less likely to smoke at baseline (79.1% vs. 93.6%, P=0.002), consumed more alcoholic drinks/month (6.8 vs. 4.1; P=0.007) and were less active (287.5 min/week of MVPA vs. 428 min/week of MVPA; P=0.003).

Additionally, a random 10% sample from the baseline 200 participants were asked to complete a one-week test-retest reliability measure from baseline. The one-week test retest consisted of completing all of the health behavior and personality assessments. The participants randomly selected for the one-week test-retest wore a pedometer for a week in an effort to assess the possible convergent validity of the self-reported physical activity assessment.

Measurement of Personality

In order to assess personality, the Neuroticism-Extraversion-Openness Five Factor Inventory (NEO-FFI) questionnaire was used. The NEO-FFI is a five factor inventory scale. The inventory consists of five 12-item scales (60 items total) that measure each domain of five factors (Neuroticism, Extraversion, Openness, Agreeableness, Conscientiousness). There are 60 statements that describe people in a general way. A sample item from the NEO-FFI

questionnaire that assesses Conscientiousness is "*I keep my belongings clean and neat*;" A sample item assessing Extraversion is "*I like to have a lot of people around me*;" A sample item assessing Openness is "*I am intrigued by the patterns I find in art and nature*;" A sample item assessing Neuroticism is "W*hen I'm under a great deal of stress, sometimes I feel like I'm going to pieces*;" and lastly, a sample item for Agreeableness is "*I would rather cooperate with others than compete with them*." Response options range from zero to four, with zero being strongly disagree and four being strongly agree. Response option two stands for neutral. The NEO-FFI provides a quick, reliable, and accurate measure of the five domains of adult (ages 17 years and older) personality.[19] Internal consistency, as measured by Cronbach's alpha, was 0.85 (neuroticism), 0.75 (extraversion), 0.75 (openness), 0.76 (agreeableness), and 0.84 (conscientiousness). The test-retest reliability assessment (ICC; absolute agreement) of the 20% random sample was 0.92 (neuroticism), 0.95 (extraversion), 0.93 (openness), 0.98 (agreeableness), and 0.96 (conscientiousness).

Measurement of Health Behavior

Physical Activity Behavior. Physical activity was assessed using the International Physical Activity Questionnaire (IPAQ). The IPAQ form asked participants about the time they spent being physically active in the last seven days. For example, a question on the form is "*How much time did you usually spend on one of those days doing vigorous physical activities in the garden or yard?*" Participants could report their answer in hours per day or minutes. Previous research shows the IPAQ to demonstrate some evidence of being reliable and valid.[20] Meeting MVPA guidelines was defined as at least 150 minutes/week. Among the 20% random sample of the present study, the correlation between IPAQ-determined MVPA and pedometer-determined

steps was, r = 0.43 (P<0.001). The one-week test-retest reliability (for IPAQ) of our 20% random sample was, ICC (absolute agreement) = 0.79

Smoking Behavior. Participants were classified as smokers if they self-reported smoking cigarettes every day or some days; otherwise, participants were classified as a non-smoker. Previous research demonstrates evidence of validity for self-reported smoking assessment.[21] The one-week test-retest reliability of our 10% random sample was, ICC (absolute agreement) = 0.91.

Alcohol Consumption Behavior. Participants were asked to complete a survey assessing alcohol consumption. Participants were asked whether in the past 12 months they "*had at least 12 drinks of any type of alcoholic beverage (drink = a 12 oz beer, a 4 oz glass of wine, or an ounce of liquor)?*" Those who answered "yes" to this question were further asked, "*In the past month, on those days that you drank, on average, how many drinks did you have* (responses ranging from "*I didn't drink in the past month" to some numeric response*)? This alcohol assessment was adopted from the National Health and Nutrition Examination Survey (NHANES) alcohol assessment. Although recognizing an inverted U-shaped relationship between alcohol behavior and health,[22] due to cell size considerations, participants were ultimately scored as a heavy alcohol drinker or not, with heavy alcohol drinking defined as >30 alcoholic drinks/month for women and >60 alcoholic drinks/month for men.[23,24] The one-week test-retest reliability of our 10% random sample was, ICC (absolute agreement) = 0.76.

Sleep Behavior. Based on the format of the Pittsburgh Sleep Quality Index questionnaire (PSQI), sleep duration was assessed by asking the participants their typical nightly sleep duration

over the past 30 days. Participants were classified as meeting sleep guidelines based on sleeping 7-9 hrs/night.[25] A modest correlation (r=0.47) has been observed between self-reported sleep duration and objectively-measured sleep duration.[26] The one-week test-retest reliability of our 10% random sample was, ICC (absolute agreement) = 0.62.

Dietary Behavior. Participants also completed an 8 item Starting the Conversation (STC) dietary questionnaire, which assesses food patterns (vs. nutrient or fat intake) and has been used as a tailored approach for dietary counseling. An example item is, "*In the past week, how many times did you eat fast food meals or snacks*?" For each of the 8 items, there are three response options, which varies based on the item. As an example, response options included "< 1 time, 1-3 times and 4+" for "How many times a week did you eat fast food meals or snacks?" For the item, "How many servings of fruits did you eat each day?" response options included, "5+, 3-4, or 2 or less." Ultimately, the summed dietary score ranged from 8-24, with higher scores reflecting a greater dietary behavior (some items reversed coded to reflect this). Given that there is no established cut-point for the STC questionnaire, this variable was dichotomized at the sample median (i.e., 18) to reflect healthier vs. less healthy dietary behavior. The STC has demonstrated evidence of feasibility, validity and sensitivity to change.[27] The one-week test-retest reliability of our 10% random sample was, ICC (absolute agreement) = 0.61.

Multibehavior and Behavioral Clustering. A multibehavior index variable was created ranging from 0-5 indicating the number of positive health behaviors they engaged in. For example, those meeting MVPA guidelines (≥150 min/week), having a healthy diet (sample median score ≥ 18), meeting sleep guidelines (7-9 hrs/night), not abusing alcohol (≤30 alcoholic drinks/month for

women and ≤60 alcoholic drinks/month for men) and being a non-smoker were given a multibehavior index score of 5. The one-week test-retest reliability of our 10% random sample was, ICC (absolute agreement) = 0.84.

In addition to this 0-5 multibehavior index variable, we created two other primary index parameters. We evaluated the association between personality types and high vs. low behavioral clustering. Taking into account cell sizes for the behaviors, high behavioral clustering was defined as having 4-5 of the health behaviors, with low behavioral clustering defined as having 2 or fewer health behaviors. Additionally, we evaluated the association between personality types and energy balance clustering. Energy balance clustering was defined as meeting physical activity guidelines and being above the median for dietary behavior. Other non-primary behavior clusters were evaluated and reported in the sensitivity analyses shown in the results section.

Measurement of Executive Function

The PGNG computer task was used to measure individual differences in EF.[28] This assessment took approximately 30 minutes to complete and requires individuals to actively regulate responses to presented stimuli and either initiate response quickly or inhibit their response. The EF construct is multi-dimensional,[9] and PGNG measures predominantly tap one facet of EF that may be particularly pertinent to behavioral self-regulation: the ability to suspend prepotent responses to external cues. Functional imaging studies have documented associations between PGNG performance and activation in the prefrontal and anterior cingulate regions of the brain;[29,30] both structures have been implicated in behavioral self-regulation in humans.[31] Detailed discussion of the factor structure and construct validity of the PGNG test is published elsewhere.[28,32]

As described elsewhere,[28] there are three levels of the PGNG task, with the present study utilizing level 3, which is consistent with other work[33] and important for young healthy adult populations (consistent with the present sample) in order to remove potential ceiling effects.[28] Utilizing computerized software, participants are presented with a series of flashing letter targets (e.g., "r", "s", and "t") intermixed with other letters (e.g., "a", "c", etc.), with each presented letter occurring at a rate of 500 ms. There are 2 primary outcome parameters, including the Simple Rule and Repeating Rule. For the Simple Rule, participants are asked to press the space bar every time the target letter (e.g., "r", "s", or "t") appears, with the outcome of this rule being the percent of correct target detection and mean reaction time. For the Repeating Rule, participants are asked to press the space bar every time they see the target letter (e.g., "r", "s", or "t"), but only if the target letter is not repeating the previous target; the outcome for this rule was the percent of correct (non-repeating) target detection and mean reaction time. For example, if the following letter sequence occurred, they would not press the space bar for the second "r" (a, t, r, p, d, r), but they would press the space bar twice (at "r" and "s") during this sequence (a, t, r, p, d, s).

Measurement of Transtheoretical Model Constructs

Stage of change. To be consistent with stages of change in the TTM, regular participation in exercise was defined as "equal to five or more days per week of at least 30-minutes at a moderate intensity." As used in previous studies, participants were asked to choose one of five statements to describe their readiness to change their exercise behavior.[34,35] The five different stages of change include precontemplation, contemplation, preparation, action, and maintenance. For example, participants who reported, "No, I do not plan to start in the next six months" were

classified in the precontemplation stage. The stage of change algorithm has demonstrated evidence of reliability and validity in adults of the general population and those with chronic diseases.[34,35] In the present sample, the one-week test-retest reliability was, ICC (absolute agreement) = 0.64.

Processes of change. To examine the *strategies* individuals use to change their exercise behaviors, a 30-item measure was used to assess both behavioral and cognitive processes of change. Fifteen items assessed behavioral process of change (BPC) (i.e., reinforcement management, counterconditioning, helping relationships, self-liberation, and stimulus control), whereas the other 15-items assessed cognitive processes of change (CPC) (i.e., consciousness raising, dramatic relief, environmental reevaluation, self-reevaluation, and social liberation). Participants were asked to respond to each question using a Likert scale, with end points ranging from 1 (never) to 5 (repeatedly). A sample BPC item is "*Instead of relaxing by watching TV or eating, I take a walk or do physical activity*." A sample CPC question is "*I believe that regular physical activity will make me a healthier, happier person*." Reliability and validity of both the behavioral and cognitive process of change have been previously established.[36] Behavioral and cognitive processes of change were calculated by summing the items for each process of change separately. Higher scores indicate higher use of behavioral processes or cognitive processes of change. In the present sample, the one-week test-retest reliability for BPC and CPC, respectively, were, ICC (absolute agreement) = 0.90, ICC (absolute agreement) = 0.91. Further, internal consistency in the present sample, as measured by Cronbach's alpha, for BPC and CPC, respectively, were, $\alpha = 0.89$, $\alpha = 0.83$.

Self-efficacy. To assess self-efficacy, or an individual's confidence in ability to overcome barriers, an 18-item measure, which has demonstrated evidence of reliability and validity, was used.[37,38] For each question, participants responded using a Likert scale, with end points ranging from 1 (not at all confident) to 5 (very confident). A sample item is "*I feel confident that I can participate in physical activity when I don't feel like it*." Items were summed, with higher scores indicating higher self-efficacy. In the present sample, the one-week test-retest reliability for self-efficacy was, ICC (absolute agreement) = 0.82. Further, internal consistency in the present sample, as measured by Cronbach's alpha, was, $\alpha = 0.92$.

Decisional balance. An individual's reflection of the pros and cons of engaging in regular physical activity, referred to as decisional balance, was evaluated using a 10-item measure. Five items assessed pros of regular exercise, whereas the other five items evaluated the cons of engaging in regular exercise. Using a Likert scale anchored by 1 (not at all) and 5 (very much), participants were asked to rate their degree of agreement with each perceived positive and negative consequence of exercise involvement. A sample item of pros for exercise is "*Physical activity would help me reduce tension or manage stress*." A sample item of cons for exercise is "*Physical activity would take too much of my time.*" This measure has previously demonstrated evidence of reliability and validity.[39] Pros and cons were scored separately by summing the respective items, with a higher pros score indicating more perceived pros of exercise and a lower cons score indicating fewer perceived cons of exercise. In the present sample, the one-week test-retest reliability for pros and cons, respectively, were, ICC (absolute agreement) = 0.93, ICC (absolute agreement) = 0.63. Further, internal consistency in the present sample, as measured by Cronbach's alpha, for pros and cons, respectively, were, $\alpha = 0.85$, $\alpha = 0.72$.

II. STUDY ONE

The Prospective Association between the Five Factor Personality Model with Health Behaviors and Health Behavior Clusters

Introduction

Health-enhancing behaviors such as physical activity, smoking avoidance, non-heavy alcohol abuse, healthy eating, and adequate sleep, may help to prevent morbidity and mortality.[3-5,40] Further, adopting such individual health behaviors may help to delay the onset of disability and attenuate the rate of functional decline.[41] Strikingly, our recent work[4] demonstrates that few (<5 %) adults in the United States concurrently adopt these health behaviors. Thus, there is an urgent need to promote the concurrent adoption of multiple health-enhancing behaviors, as our recent work also demonstrates that those who adopt more health behaviors tend to have better cardiovascular disease risk profiles[4] and are at a reduced risk of premature mortality.[40]

In addition to the promotion of concurrent adoption of the above-mentioned health behaviors, our work[42,43] suggests that there may be a differential effect of unique health-behavior clusters on health status. For example, Loprinzi[42] demonstrated that the adoption of more health behaviors was associated with reduced odds of multimorbidity, whereas the two health behavior clusters associated with multimorbidity were physical activity and sleep as well as physical activity and nonsmoking. The differential clustering effect may also be unique to the health outcome as, recently, Loprinzi[43] demonstrated that the health behavior clusters of physical activity and nonsmoker, as well as diet and sleep were associated with lower levels of systemic

inflammation. Similarly, other work,[41,44-47] across varying populations and health outcomes, also suggests that, in addition to the importance of concurrent adoption of more health-enhancing behaviors, health behavior clusters may have unique synergistic effects on health.

Identification of evidence-based approaches to increase the likelihood of concurrent behavioral adoption is of major public health interest. Various theoretical models, such as the social cognitive theory, TTM, and theory of triadic influence, provide insight on how to accomplish this.[48,49] Additionally, and as we have discussed within various behavioral domains, including physical activity,[50,51] diet[42,52] and smoking,[50,51,53] it is plausible that changing one health behavior may help to foster changes in other health behaviors. This may occur through a variety of mechanisms, including, for example, via changes in behavior-induced cognitions (e.g., executive function[54]) and psychological-based self-efficacy.[51] In addition to these potential antecedents to multibehavior and behavioral clustering, personality trait characteristics plausibly play an important role in single, multibehavior, and behavioral clustering change.

To describe personality, psychologists use a widely examined theory that suggests there are five broad dimensions of personality. The Big Five personality traits include neuroticism, extraversion, conscientiousness, openness to experience, and agreeableness. This higher order trait taxonomy characterizes each of the five personalities, including, *neuroticism* (i.e., feelings of anxiety, anger, guilt, frustration), *extraversion* (i.e., manifested in outgoing, talkative, energetic), *conscientiousness* (i.e., vigilant, careful, organized, aim for achievement), *openness to experience* (i.e., intellectual curiosity, perceptive, creative, reflective), and *agreeableness* (i.e., kind, cooperative, sympathetic, trustworthy).[1] Previous research suggests that personality is linked with a multitude of health-enhancing (e.g., physical activity, healthy eating, adequate sleep) and health-compromising behaviors (e.g., alcohol abuse, smoking).[2]

In regards to clustering of health behaviors, physical activity, like the other behaviors, is a key health behavior that has the potential to prevent numerous diseases.[55,56] Therefore, it serves importance to examine specific personalities that may exhibit lower levels of physical activity. For example, individuals who express high levels of neuroticism tend to be less physically active than those who express lower levels of neuroticism.[1] A potential explanation for this finding is that individuals with higher levels of neuroticism tend to experience high levels of anxiety and this may pose as a potential barrier to physical activity participation. Furthermore, individuals who have higher levels of conscientiousness, tend to be more physically active,[1] which may be a result of their increased awareness of the importance of living an active lifestyle. The extant literature suggests there is no present evidence to associate agreeableness with physical activity.[1] With regard to openness to experience, the majority of research demonstrates a null association with physical activity.[1]

Personality has also been associated with other health behaviors such as smoking, dietary behavior, alcohol use, and sleep.[2] The personality trait neuroticism has been suggested to have a negative association with these health behaviors.[2] In contrast, conscientiousness has been shown to favorably associate with each of these health behaviors, i.e., positive association with diet and sleep, and inverse association with smoking and alcohol.[2] Extraversion, openness to experience, and agreeableness have inconclusive findings in the literature when examining the relationship to these specific health behaviors.[2] Collectively, these findings suggest that those with higher levels of neuroticism are more likely to engage in health compromising behaviors such as smoking, poor diet, not meeting sleep recommendations, and a poor diet. In contrast, individuals with higher levels of conscientiousness may be more likely to engage in health enhancing

behaviors such as meeting sleep recommendations, consuming a healthy diet, and participating in regular physical activity.

Although studies have examined the associations between personality and these individual health behaviors,[57] less research has evaluated the association between personality and multibehavior as well as the clustering of health behaviors.[58] Further, the majority of research on this topic (i.e., personality and individual, multibehavior and behavioral clustering) have employed cross-sectional study designs. Thus, the purpose of this study was to overcome these gaps in the literature. Specifically, the aim of this study was to examine the prospective association of personality with individual, multibehavior and clustering of behavior engagement and behavior change. Based on findings in the literature, we hypothesized that the personality trait conscientiousness would be positively associated with health-enhancing behaviors (and clusters) and neuroticism, in particular, would be inversely associated with health-compromising behaviors. These findings may help to identify which personality traits may be susceptible to an overall unhealthy profile.

Methods

For the methodology of this study, refer to chapter 2 of this thesis document.

Data Analysis

All analyses were performed in Stata (v. 12). Multivariable linear and logistic regression analyses were used to assess the association between baseline personalities with each of the individual health behaviors (and multibehavior as well as behavioral clusters) assessed at the 5-month follow-up period. Further, a multivariable ordinal regression model was used to assess the

association of baseline personalities with the follow-up multibehavior index variable. For each of the health behaviors, two regression models were computed. For Model 1, covariates included age, gender, race-ethnicity, education, perceived health status (excellent, very good, good, fair or poor), measured baseline body mass index (kg/m^2), and follow-up duration (months; follow-up minus baseline). Model 2 was the same as Model 1 except in Model 2 the baseline health behavior was also included as a covariate. Additionally, for the health behaviors measured in a continuous scale (i.e., diet and MVPA), a third model was computed that included the "change" score for that respective variable in the model (e.g., $MVPA_{time2} - MVPA_{time1}$). For both models, all 5 personality traits were included in the model. In all models, there was no evidence of multicollinearity (e.g., highest individual variance inflation factor was 1.9). Statistical significance for all models was set at an alpha level of $P<0.05$.

In an effort to minimize regression dilution bias, i.e., measurement error in the exposure, we also estimated a corrected regression coefficient by calculating a reliability ratio, as described elsewhere.[59] Briefly, our calculated reliability ratio was the ICC from the test-retest reliability assessment. The corrected regression beta coefficient for each personality trait (with the health behavior as the outcome) was calculated as the observed regression coefficient divided by the reliability ratio. This approach is only applicable to simple linear regression models;[59] thus, this approach was applied to simple linear regression models (Table 4) for diet (summed score ranging up to 24), MVPA (min/week), alcohol drinks (per month) and sleep duration (min/night of sleep); notably, this approach was not applied to the smoking data given that it was scored as a binary variable.

Results

Study variable characteristics are displayed in Table 1A[1]. Participants of the sample included 81% undergraduate students and the remaining 19% were graduate students. Mean age for the participants was 21.6 years, ranging from 18-33. The mean follow-up duration was 159.6 days (approximately 5.3 months), ranging from 111-241 days (approximately 3.7-8.0 months).

With regard to Model 2 (Table 2A), which controlled for the respective health behavior at baseline (along with the other covariates), the personality traits extraversion, openness to experience, and agreeableness were associated with alcohol intake, respectively, (OR: 1.22, 95% CI: 1.0-1.48, P=0.05), (OR: 0.87, 95% CI: 0.76-0.99, P=0.04), (OR: 0.84, 95% CI: 0.72-0.99, P=0.03). The health behaviors smoking and MVPA were not significantly associated with any of the personality traits. However, when examining MVPA as a continuous variable, the personality trait conscientiousness was associated with higher MVPA (95% CI: 4.08-29.75, P=0.01). The personality trait conscientiousness was associated with a healthy diet (OR: 1.11, 95% CI: 1.01-1.21, P=0.02). In regards to sleep, extraversion was associated with this behavior (OR: 0.91, 95% CI: 0.83-0.99, P=0.04).

Table 3A reports the multibehavior and behavioral clustering results. As shown in Model 1, after adjusting for baseline multibehavior, age, gender, race-ethnicity, education, health status, body mass index and duration of follow-up, neuroticism (β= -0.02; 95% CI: -0.07-0.02), extraversion (β= -0.01; 95% CI: -0.08-0.05), openness (β= -0.02; 95% CI: -0.07-0.02), agreeableness (β= -0.01; 95% CI: -0.07-0.05) and conscientiousness (β=0.01; 95% CI: -0.04-0.07) were not associated with multibehavior. As shown in Model 2 of Table 3A, extraversion was associated with high (vs. low) behavioral clustering (OR=1.18; 95% CI: 1.00-1.40). As shown in Model 3 of Table 3A, conscientiousness was associated with energy balance clustering

[1] All tables are in the appendix.

(OR=1.09; 95% CI: 1.01-1.17). Although not shown in tabular format, we also evaluated other types of energy balance clusters by evaluating the association personality and the concurrent adoption of meeting MVPA and sleep guidelines, as well as being above the median dietary score, but none of the personality traits were associated with this 3-variable energy balance cluster (data not shown). Similar, none of the personality traits were associated with the 2-energy balance clusters of MVPA and sleep or sleep and diet (data not shown).

Table 4A displays the corrected regression beta coefficients for the individual health behaviors. Notably, the slopes, for the association between each personality trait and the health behaviors, were similar when comparing the uncorrected vs. corrected slopes.

Discussion

Previous work demonstrates that concurrent adoption of multiple health-enhancing behaviors, as well as differing clusters/combinations of these health behaviors, may have profound effects on health. Although previous research has evaluated the association of personality on individual health behaviors, mostly via cross-sectional designs, there has been limited investigation of the prospective associations of personality on multibehavior and behavioral clustering. This was the aim of this investigation. Our main findings were that 1) extraversion, conscientiousness, openness to experience, and agreeableness were associated with select individual health-related behaviors, 2) extraversion was associated with high behavioral clustering (i.e., engaging in the majority of the health-enhancing and health-compromising behaviors), and 3) conscientiousness was associated with energy balance clustering. The narrative that follows will discuss our findings in the context of the individual health behaviors, followed by the multibehavior and behavioral clustering results.

One of the findings of this study was that personality traits extraversion, openness to experience, and agreeableness were associated with heavy alcohol consumption. Sensation seeking and impulsivity are traits associated with alcohol involvement in the university population.[60] Sensation seeking has been defined as the desire for novel and stimulated experiences and the openness to take risks for the experience.[61] Therefore, it is plausible to suggest that individuals with higher levels of openness to experience and agreeableness are more likely to engage in heavy alcohol consumption. Individuals displaying high levels of agreeableness may be more susceptible to be involved in situations where alcohol is available. Magid et al. [62] suggest impulsivity and sensation seeking to both be significantly related to social motives, which would help explain why the personality trait extraversion, in particular, was found to be associated with heavy alcohol consumption.

When examining MVPA as a continuous variable, conscientiousness was associated with this health-enhancing behavior. Conscientiousness may serve importance as it has been suggested to be pertinent in action control.[63] Various studies looking at the personality trait conscientiousness have demonstrated that people with higher levels of this specific trait have better health practices and live longer.[64] In alignment with this, the present study's findings also demonstrate that conscientiousness was associated with meeting dietary behavior guidelines. Individuals with high levels of conscientiousness are thought to be more dutiful, orderly, and self-disciplined.[65] It is plausible to suggest that these characteristics of dutiful, orderly, and self-disciplined may play an integral part in action control and may explain why conscientiousness was associated with more physical activity and healthier eating.

The personality trait extraversion was associated with meeting sleep guidelines. Personality and sleep associations are inconclusive among the research.[66-68] People with higher

levels of extraversion tend to enjoy social settings with activity. One definition of 'activity' is the need to keep oneself busy, active and engaged in vigorous movement.[19] Due to the potential fast-paced nature of some social settings and activeness, it is plausible to suggest that individuals who prefer these settings (i.e., extroverted), may exhibit the need for 7-9 hours of sleep. Of course, this is purely speculative and in need of corroboration. Other unknown explanations are likely more plausible, as in this sample, extraversion was associated with heavy alcohol consumption, which has been shown to unfavorably associate with sleep patterns and sleep quality.[69]

The most popular personality trait model defines neuroticism as the tendency to be in a negative emotional state, anxious, self-conscious, and vulnerable.[1] The results of our study demonstrated neuroticism was not associated with any of the individual health behaviors (or multibehavior). Perhaps this is due to the levels of self-consciousness and anxiety exhibited by neurotic individuals. Research suggests that a high degree of harm avoidance or neuroticism is associated with a large activation in the insula during a risky response.[70] The degree of risk taking is largely related to the degree of activation in the insula, where consciousness takes place. Specifically, a large activation in the insula during a risky response is associated with a lower inclination to select a risky response.[70] Therefore, it is plausible to suggest that the present study did not observe any associations with the health behaviors because individuals with high levels of neuroticism tend to avoid harmful situations.

With extraversion being characterized by the tendency to be sociable, assertive, energetic, and seek excitement, it is understandable that this personality trait was associated with high (vs. low) behavioral clustering. Providing additional plausibility for this extraversion-behavioral clustering relationship is that previous work has demonstrated that extraversion is associated

with several of the health behaviors evaluated herein.[1,2] Interestingly, the personality trait conscientiousness was specifically associated with energy balance clustering. Rhodes et al.[71] suggest activity represents a disposition toward a fast lifestyle, representing high energy, fast talking, and keeping busy. While this facet is mainly organized under the extraversion trait, it has also been suggested as a sub-trait of conscientiousness. Costa et al.[72] suggests that conscientiousness displays organizational properties and goal achievement strategies necessary for this trait to manifest. Further, conscientiousness displays self-regulation behavioral tactics which may explain why this personality trait was associated with energy balance clustering. This is in alignment with work demonstrating an indirect link between conscientiousness and dietary behavior, mediated by reduced emotional eating, restrained eating and reduced external eating;[73] this suggests that highly conscientious individuals adopt regulatory dietary restraint and practice counter-regulatory emotional or external eating. In the context of the other behavior (physical activity) of this energy balance cluster, self-regulatory components (e.g., inhibition, set-shifting, goal-setting) play an important role in influencing physical activity behavior.[74] The conscientiousness personality type may indirectly influence physical activity via enhanced self-regulatory abilities among such individuals.[75]

Due to the self-report nature of the health behavior assessments, our results may be limited because of social or recall bias. With the population consisting of college aged students, a limitation of this study is the limited generalizability to other ages and populations. Further, our analyzed follow-up sample differed than the initial baseline cohort for alcohol, smoking and physical activity, suggesting that our findings in these behavioral domains may have less generalizability. Notably, however, personality is considered to be stable across cultures, and therefore, the findings of this study may relate cross-culturally.[1] Notable strengths of this study

include the comprehensive assessment of individual, multibehavior and behavioral clusters, employing a prospective study design, incorporating a test-retest subsample (inclusive of pedometry assessment) and correcting for regression dilution bias, which is extremely uncommon in epidemiological studies.[76] Future research would benefit by overcoming our study limitations as well as investigating lower-order personality traits (type A personality) on changes in health behaviors.[77]

In conclusion, personality traits were differentially associated with select health behaviors, extraversion was associated with high behavioral clustering and conscientiousness was associated with energy balance clustering. The strength of these observed associations were relatively small, which is in alignment with other personality-behavior studies.[19] Determining personality types may be useful in identifying at risk populations. That is, based on our observations, individuals with high levels of extraversion, openness to experience, and agreeableness may be at risk for alcohol-related diseases. The results from this study suggest that when evaluating individual, multiple and behavioral clusters among the college aged population, it may serve importance to consider personality assessment.

III. STUDY TWO

Longitudinal Evaluation of Whether Executive Function Moderates the Relationship Between Personality and Physical Activity

Introduction

Physical inactivity is often considered as minimal bodily movement or insufficient levels not meeting current recommendations.[78] Strong evidence shows that physical inactivity increases the risk of many adverse health conditions, such as increased risk for obesity, cardiovascular disease, type 2 diabetes, breast and colon cancers, or even mortality.[79] Certain personality traits have been associated with physical activity.[1] The most popular personality trait model incorporates a five part taxonomy: *neuroticism* (i.e., tendency to be in a negative emotional state, anxious, self-conscious, and vulnerable), *extraversion* (i.e., tendency to be gregarious, assertive, energetic, and seek excitement), *openness to experience/intellect* (i.e., tendency to be perceptive, creative, reflective, and aesthetic), *agreeableness* (i.e., tendency to be kind, cooperative, sympathetic, warm, and trustworthy), and *conscientiousness* (i.e., tendency to be ordered, dutiful, self-disciplined, and achievement oriented).[1] The personality trait neuroticism has been suggested to be negatively associated with physical activity.[1] Specifically, individuals with higher levels of neuroticism, tend to participate in lower levels of physical activity. One possible explanation for this association is individuals with higher levels of neuroticism typically have high levels of anxiety,[80] and in return are less physically active.[80] On the contrary, the personality trait extraversion has been positively associated with physical activity.[1] Individuals with high levels of extraversion may use physical activity as a social event.

Executive function has also been shown to play an important role in influencing physical activity.[81] The term EF is a broad umbrella term for the cognitive processes that help individuals regulate, control, and manage thoughts and actions.[8] Executive function improvement is also linked with increased physical activity.[82] Additionally, research demonstrates that EF is also related to personality.[7] That is, in general, the personality trait neuroticism is inversely associated with EF, whereas the personality type 'openness' was positively associated with EF. The traits extraversion and conscientiousness appear to be unrelated to EF.

However, despite the noted information in the above paragraph, the prospective interrelationships of personality, physical activity, and EF have not been extensively studied. Therefore, the purpose of this study was to examine the prospective relationship between personality and physical activity and whether EF moderates this relationship. It is plausible to suggest that, for example, neuroticism may be associated with lower EF,[7], which in turn, may be associated with reduced physical activity. Similarly, it is plausible to suggest that openness to experience/intellect may be associated with increased EF, which in turn, may be associated with increased physical activity. This unexplored investigation is important to examine because it may identify personality traits that may influence physical activity and examine the extent to which EF influences this relationship. This may help to inform the development of physical activity interventions by specifically designing programs that takes into consideration both personality type and EF level.

Methods

For the methodology of this study, refer to chapter 2 of this thesis document.

Data Analysis

All analyses were performed in Stata (v. 12). Multivariable linear regression analyses were used to assess the association between baseline personalities with 5-month follow-up MVPA. A single model was evaluated that included a five personality traits along with the covariates: baseline MVPA, age, gender, race-ethnicity, education, perceived health status (excellent, very good, good, fair, or poor), measured body mass index (kg/m^2) and duration of follow-up (months). There was no evidence of multicollinearity (e.g., highest individual variance inflation factor was 1.9) in this model. Additionally, potential multiplicative interaction effects for EF and personality on follow-up MVPA were evaluated by creating a cross-product term of the individual personality trait and EF, and including this term along with the main effects and covariates, in the model. Statistical significance for all models was set at an alpha level of $P<0.05$.

Results

Table 1B displays the characteristics of the analyzed sample. Participants, on average, were 21.6 years, with the majority of participants being female (62%) and non-Hispanic white (66%).

Table 2B displays the multivariable linear regression evaluating the association between personality and 5-month follow-up MVPA. Results demonstrated that baseline MVPA ($\beta = 0.24$; 95% CI: 0.02, 0.46; P=0.02) and race-ethnicity ($\beta = -225.2$; 95% CI: -384.3, -66.2; P=0.006) were covariates independently associated with 5-month follow-up MVPA; with regard to the latter, minority race-ethnicities engaged in less 5-month follow-up MVPA than non-Hispanic

whites. Independent of baseline MVPA and race-ethnicity (along with the other covariates), individuals with a higher baseline conscientiousness personality type had greater 5-month follow-up MVPA (β = 18.5; 95% CI: 5.3, 31.7; P=0.006).

Although not shown in tabular format, there was no evidence of an interaction effect for personality trait and EF on 5-month follow-up MVPA. The interaction coefficients were as follows for percent correct detection for the repeating rule and neuroticism (β = 0.06; 95% CI: -0.44, 0.56; P=0.88), extraversion (β = 0.15; 95% CI: -0.48, 0.78; P=0.64), openness (β = -0.008; 95% CI: -0.61, 0.60; P=0.97), agreeableness (β = 0.24; 95% CI: -0.42, 0.92; P=0.46) and conscientiousness (β = -0.02; 95% CI: -0.70, 0.65; P=0.93). Results were similar when considering mean reaction time for the repeating rule, percent correction detection for the simple rule and mean reaction time for the simple rule (data not shown).

Discussion

It is widely noted that physical activity improves health and activities of daily living.[15,83] Certain personality traits are positively associated with physical activity, while some are negatively associated with physical activity.[1] Further, research demonstrates that physical activity may help to improve EF.[15,84-86] Even more so, improvement in EF has been linked with physical activity [82] and personality.[7] Although these parameters have been investigated individually, we are aware of no single prospective study that has evaluated all three of these parameters collectively. Thus, the purpose of this study was to examine the prospective relationship between personality and physical activity and whether EF moderates this relationship. When examining the prospective association between personality and physical

activity, conscientiousness was the only personality type that showed greater 5-month follow-up MVPA. Specifically, those who had higher baseline conscientiousness demonstrated to be more physically active over time. Previous research has suggested conscientiousness to be most strongly related to participation in exercise behavior because of the goal to protect health.[87] Typically, the personality trait extraversion is associated with increased levels of physical activity.[1] However, this was not the case in our study. A plausible explanation for this is there may have been more introverted personality types than extroverts in our study population. The personality traits neuroticism, openness to experience, and agreeableness also showed null associations in regards to physical activity. In the college population, individuals with high levels of neuroticism tend to worry and have high levels of anxiety and therefore may avoid being physically active. During this time in a young adult's life, they are open to experience and are willing to try new things. Therefore, it is plausible to suggest individuals with higher levels of openness to experience may want to try more exciting activities instead of physical activity.

The results of the study did not demonstrate any observable evidence that EF moderated the relationship between personality and physical activity. These findings are difficult to explain, but one potential reason is that, perhaps, personality type is more enduring and stable, and thus, exerts a more pronounced effect on physical activity, whereas EF or cognitive function in general, may be more variable.[88] Given the novelty of this exploration, future research should continue to evaluate this topic, but consider multiple assessments of EF to see how changes in EF may influence the prospective relationship between personality and physical activity.

Limitations of the study include the subjective assessment of physical activity; however, we did provide evidence of test-retest reliability of this measure as well as convergent validity via pedometry assessment. With the population consisting of college aged students, a limitation

of this study is the limited generalizability to other ages and populations. Strengths of this study include the study's novelty and employing a prospective study design.

In conclusion, the personality trait conscientiousness demonstrated a positive association with changes in physical activity. Executive function did not demonstrate a moderational role between personality and physical activity. Thus, personality may exert its effects on physical activity regardless of EF level.

IV. STUDY THREE

Prospective Results from the PA (Personality and Activity) Project: Evaluating the Influence of the Transtheoretical Model on Physical Activity While Considering Personality Trait Characteristics

Introduction

Despite the health-promoting benefits of physical activity, the majority of individuals still engage in low levels of physical activity.[89,90] Due to inadequate levels of physical activity participation, researchers have been actively seeking to identify theories to promote healthy behaviors and develop effective interventions.[89,90] One important health-promoting behavior change model is the TTM.[16] The TTM consists of a framework of five discrete stages adopted to study behavior change. These stages include precontemplation, contemplation, preparation, action, and maintenance.[89] Core to the TTM includes various constructs, including *behavioral and cognitive processes of change*, *decisional balance*, and *self-efficacy*. A vast amount of research suggests that TTM is useful in promoting physical activity behavior change.[17] The TTM has been shown to be effective in promoting physical activity across various populations, including children/adolescents,[91] adults in the general population,[92] and adults with chronic disease.[93]

Recently, Choi et al. suggested that psychosocial variables such as personality were related to the promotion of physical activity.[89] Individuals with greater self-efficacy are more likely to seek and utilize health-promoting behaviors such as exercise.[94] Additionally, the personality trait conscientiousness has been negatively correlated with unhealthy behaviors and

positively related to exercise-related self-efficacy.[64,95] However, the utility of the TTM in promoting physical activity behavior across varying personality traits has not been fully investigated. Evidence has demonstrated that the stages of change (e.g., precontemplation) are associated with personality traits.[89] Reporting oneself as being conscientious and using avoidant-focused coping strategies, the results of the Choi et al. study found this personality trait (conscientiousness) to significantly differentiate between the stages of change, but did not predict later stages of behavior change. Further, evidence suggests that, in addition to self-efficacy, psychological factors including introversion, neuroticism, psychosocial stress, and social support were significantly associated with later stages of change (i.e., more consistent physical activity).[89] However, there is a gap in the literature examining the extent to which TTM strategies (i.e., processes of change, decisional balance and self-efficacy) associate with physical activity behavior across different personality traits. Despite the degree of TTM being effective in multiple populations, we hypothesize that personality may moderate the utility of the TTM in predicting physical activity.

The most popular personality trait model incorporates a five part taxonomy: *neuroticism* (i.e., tendency to be in a negative emotional state, anxious, self-conscious, and vulnerable), *extraversion* (i.e., tendency to be gregarious, assertive, energetic, and seek excitement), *openness to experience/intellect* (i.e., tendency to be perceptive, creative, reflective, and aesthetic), *agreeableness* (i.e., tendency to be kind, cooperative, sympathetic, warm, and trustworthy), and *conscientiousness* (i.e., tendency to be ordered, dutiful, self-disciplined, and achievement oriented).[1] Previous research demonstrates that extraversion and conscientiousness are positively associated with physical activity. Conversely, personality traits neuroticism, openness to experience, and agreeableness either demonstrate a mull or inverse association with physical

activity.[1] Collectively, these findings suggest that personality characteristics may influence the utility of the TTM in influencing physical activity. This, to our knowledge, has yet to be investigated in the published literature. Therefore, the purpose of this study was to examine the prospective association of each of the TTM strategies on physical activity, with considerations by personality type. We hypothesize that TTM strategies (behavioral/cognitive processes of change, decisional balance and self-efficacy) will associate with physical activity, and personality type will moderate this association. Specifically, and given the inverse associations of neuroticism on physical activity, we hypothesize that the TTM constructs will not associate with physical activity among those with high levels of neuroticism.

Methods

For the methodology of this study, refer to chapter 2 of this thesis document.

Data Analysis

All analyses were performed in Stata (v. 12). Multivariable linear regression analyses were used to assess the association between baseline TTM constructs with 5-month follow-up MVPA. A single model was evaluated that included each of the following covariates: baseline MVPA, each of the five personality types, age, gender, race-ethnicity, perceived health status (excellent, very good, good, fair, or poor), measured body mass index (kg/m^2) and duration of follow-up (months). There was no evidence of multicollinearity (e.g., highest individual variance inflation factor was 2.6) in this model. Additionally, potential multiplicative interaction effects for each of the TTM constructs and each personality trait on follow-up MVPA were evaluated by creating a cross-product term of the individual TTM construct and the individual personality

trait, and including this term along with the main effects and covariates, in the model. Statistical significance for all models was set at an alpha level of $P<0.05$.

Results

Table 1C displays the characteristics of the analyzed sample. Table 2C displays the multivariable linear regression results evaluating the association between the TTM constructs and 5-month follow-up MVPA. Results showed that, after adjustments, the only TTM construct associated with follow-up MVPA was behavioral processes of change ($\beta = 10.0$; 95% CI: -0.34, 20.37; P=0.05). Although not shown in tabular format, we also evaluated potential interaction effects of each of the TTM constructs on each of the personality traits on follow-up MVPA. Notably, there were no significant interaction effects for any of the interaction models (all P's>0.05).

Discussion

Due to low levels of physical activity,[96] behavior change strategies are important to identify, develop and implement in physical activity-based interventions. One approach that has attempted to explain when and how people are likely to change their exercise behavior is through the use of the TTM.[97] Individual differences in personality may influence the use of the TTM when promoting physical activity. For example, high neuroticism or low conscientiousness has been identified as a negative predictor of self-efficacy and low physical activity.[98] Perhaps, utilizing the TTM to improve self-efficacy among highly neurotic or less conscious individuals will in turn increase physical activity levels. Additionally, the TTM construct of the cognitive processes of change, consciousness-raising, may be useful in individuals with low

conscientiousness to promote physical activity.[95] Consciousness-raising includes efforts to acquire information and a better understanding of a specific behavior, in this case physical activity. It is plausible to suggest that understanding the benefits of physical activity will increase overall physical activity levels. However, there is limited prospective data on the potential moderational effects of personality on the relationship between the TTM constructs and physical activity. This study sought to explore this specific gap in the literature.

The TTM construct processes of change include strategies used to change one's behavior and processes through the stages of change.[16] Behavioral processes of change consists of five processes (i.e., helping relationships, counterconditioning, reinforcement management, stimulus control, social liberation).[99] Helping relationships refers to social support, counterconditioning refers to substituting the problematic behavior, reinforcement management refers to self-reward for change, stimulus control refers to removing cues for unhealthy habits, and social liberation refers to commitment to change. Behavioral processes of change have been hypothesized to increase in a linear fashion up to the action stage of the TTM and then level off during the maintenance stage.[17,100] In the present study, the only TTM construct associated with follow-up MVPA was behavioral processes of change. It is plausible to suggest that only behavioral processes of change was associated with follow-up MVPA because behavioral processes of change tend to be used more in the later stages of change. Therefore, since our sample was a relatively active sample, this could explain why this TTM strategy emerged as a predictor of MVPA.

The present study also evaluated potential interaction effects of each of the TTM constructs on each of the personality traits on follow-up MVPA. Notably, there were no significant interaction effects for any of the interaction models. Therefore, in our sample, this

suggests that personality did not play a moderational role. We anticipated that certain personality traits, such as neuroticism, would moderate the relationship between the TTM and MVPA. Although speculative, our null interaction findings may be driven by our highly active sample. It seems plausible that in a sample with greater variability in MVPA behavior (inactive to active participants), personality may alter the association between the TTM constructs and future MVPA. As an example, a highly neurotic individual in the contemplation or preparation behavioral stage with intent to become more active in the future may be less likely to indeed become active in the future, even if they have sufficient pros and self-efficacy, because of the potential offsetting anxiety effects of neuroticism. Future research should continue to explore this topic using a more diverse sample with regard to physical activity behavior.

With the population consisting of strictly college students, currently residing in a Southern part of the United States, a limitation of this study is the limited generalizability to other populations. Further, the health behavior physical activity was assessed via self-report and are therefore subject to limitations such as recall and social desirability bias. Notable strengths of this study include the study's novelty, employment of a prospective study design and incorporating a test-retest subsample (inclusive of pedometry assessment).

In conclusion, the only TTM construct associated with follow-up MVPA was behavioral processes of change. Personality did not appear to play a moderational role regarding the relationship between the TTM and MVPA. Future research would benefit by overcoming our study limitations as well as investigating lower-order personality traits (type A personality) on changes in physical activity behavior and utility of TTM constructs.

V. CONCLUSION

This thesis PA (personality and activity) project aimed to explore three distinct, yet related topics, with personality and physical activity being the overarching themes. Personality has been cross-sectionally examined in regards to select health behaviors, and **Study 1** of this thesis sought to evaluate this topic using a prospective design and also evaluated other health behaviors and clusters, adding additional contributions to the field. Personality traits were differentially associated with select health behaviors. Specifically, extraversion, openness to experience, and agreeableness were associated with alcohol intake, conscientiousness was associated with MVPA (when expressed as a continuous variable) and a healthy diet. Sleep was associated with the personality trait extraversion. In regards to clustering of health behaviors, the personality trait extraversion was associated with high behavioral clustering and conscientiousness was associated with energy balance clustering (physical activity and dietary behavior). Based on these observations, the results from this study aid in identifying individuals susceptible to an overall unhealthy profile. The results from this study suggest that when evaluating individual, multiple and behavioral clusters among the college aged population, it may serve importance to consider personality assessment.

Since physical activity is a health behavior that is often underperformed,[89,96] various models have been utilized to explain or increase physical activity levels. Recent work has emphasized a cognitive-based model[74] demonstrating that an individual's degree of EF may play an important role in initiating and shaping physical activity via enhanced self-regulatory mechanisms. **Study 2** of this thesis examined EF as a potential moderator of physical activity

among different personality types. We hypothesized that individuals with higher levels of neuroticism would have lower levels of EF, and in turn, lower levels of physical activity. On the contrary, we suggested individuals with higher levels of openness to experience would have higher levels of EF, and thus, engage in higher levels of physical activity. However, results from this study demonstrated that EF did not play a moderational role between personality and physical activity. Therefore, it is plausible to conclude that personality may exert its effects on physical activity regardless of EF level. Future work, however, should evaluate this topic in other populations (e.g., older adults) that may have greater variations in EF, and thus be more susceptible to EF-induced inactivity.

Another theoretical framework utilized to promote physical activity among individuals is the TTM. The constructs of the TTM have mostly been studied cross-sectionally, but **Study 3** of this thesis sought to examine the prospective role of TTM constructs on physical activity with considerations of personality. Behavioral processes of change was the only TTM construct associated with follow-up physical activity, but, personality did not appear to play a moderational role regarding the relationship between the TTM and physical activity.

Couched within the above, the findings of this thesis suggest that in this young adult population, both personality type and constructs from the TTM (behavioral processes of change, in particular) may have a distinct influence on physical activity. If confirmed by additional research, this will emphasize the need for physical activity interventions to utilize both behavioral and cognitive-based strategies to maximize intervention adherence rates. Considering personality type and constructs from the TTM may be a useful starting point for such interventions. Future research should prospectively examine other potential moderators of personality and physical activity as well as other possible theoretical models such as the social

cognition model or physical activity-affect model. Specifically, we are interested in evaluating whether personality characteristics moderate the relationship between exercise-induced affect and future exercise behavior. Additionally, and as shown in Figure 1 (appendix), this thesis is related to the bottom-half of this model, and our future work will address the top half of the model that considers the effects of personality, EF and TTM on sedentary behavior.

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APPENDIX

Table 1A. Characteristics of the study sample (N=126).

Study Variable	Mean/Proportion	Standard Deviation
Age, mean years	21.6	2.3
Gender, % female	61.9	
Education, % undergraduate students	81.0	
Ethnicity, percent non-Hispanic white	66.0	
BMI, mean kg/m^2	25.8	6.9
Health Status		
% excellent	16.6	
% very good	47.6	
% good	30.9	
% fair	4.7	
MVPA at baseline, mean min/week	428.0	353.3
MVPA at follow-up, mean min/week	571.5	408.5
% meets guidelines at baseline[a]	78.5	
% meets guidelines at follow-up[a]	89.6	
% non-smoker at baseline	93.6	
% non-smoker at follow-up	91.2	
Alcohol at baseline, mean drinks/month	4.1	3.9
Alcohol at follow-up, mean drinks/month	4.3	6.7
% not a heavy drinker at baseline	84.1	
% not a heavy drinker at follow-up	84.9	
Diet score at baseline, mean healthy diet (8-24)	17.9	2.3
Diet score at follow-up, mean healthy diet (8-24)	17.7	2.5
% healthy diet at baseline	61.1	
% healthy diet at follow-up	52.4	
Sleep at baseline, duration hrs/day	6.7	1.1
Sleep at follow-up, duration hrs/day	7.3	1.2
% healthy sleep at baseline	46.8	
% healthy sleep at follow-up	36.5	
Overall Behavior Score at baseline, mean	3.6	0.9
Overall Behavior Score at follow-up, mean	3.5	0.9
% High behavioral clustering (4-5) behaviors at	54.7	
% High behavioral clustering (4-5) behaviors at	55.5	
% Energy balance cluster at baseline meeting	54.0	
% Energy balance cluster at follow-up meeting	50.8	
Follow-up duration, mean days	159.6	24.4

BMI body mass index

MVPA, moderate/vigorous physical activity

[a] MVPA for at least 150 minutes/week

[b] 7-9 hours of sleep/day

Table 2A. Multivariable logistic regression association between personality type and individual health behaviors (N=126).

	Odds Ratio (95% CI)†											
	Meeting MVPA Guidelines			**Non-Smoker**		**Non-Heavy Alcohol Drinker**		**Healthy Diet**			**Meets Sleep Guidelines**	
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 3	Model 1	Model 2
N	1.0 (0.92-1.09)	0.97 (0.88-1.08)	7.79 (-3.4-19.0)	1.02 (0.93-1.12)	0.98 (0.88-1.10)	0.96 (0.89-1.04)	0.96 (0.87-1.06)	1.01 (0.96-1.06)	1.01 (0.95-1.07)	0.02 (-0.02-0.08)	0.96 (0.91-1.02)	0.97 (0.92-1.03)
E	1.08 (0.94-1.25)	1.0 (0.85-1.18)	-0.03 (-16.7-16.6)	0.96 (0.83-1.10)	0.89 (0.74-1.07)	**1.19 (1.04-1.36)**	**1.22 (1.0-1.48)**	1.04 (0.96-1.13)	1.03 (0.94-1.12)	0.04 (-0.04-0.12)	0.94 (0.86-1.02)	**0.91 (0.83-1.00)**
O	1.0 (0.90-1.11	0.97 (0.86-1.10)	-6.8 (-19.5-5.8)	0.96 (0.87-1.06)	0.93 (0.83-1.05)	0.93 (0.84-1.03)	**0.87 (0.76-0.99)**	0.97 (0.91-1.03)	0.97 (0.91-1.04)	-0.01 (-0.07-0.05)	1.04 (0.98-1.11)	1.04 (0.97-1.11)
A	0.98 (0.86-1.11)	1.03 (0.89-1.18)	5.3 (-10.3-21.1)	1.09 (0.96-1.25)	1.12 (0.96-1.30)	**0.83 (0.73-0.95)**	**0.84 (0.72-0.99)**	0.97 (0.90-1.04)	0.96 (0.89-1.05)	-0.04 (-0.12-0.03)	1.02 (0.94-1.10)	1.04 (0.95-1.13)
C	1.02 (0.90-1.15)	0.98 (0.85-1.13)	4.4 (-10.8-19.7)	1.04 (0.92-1.17)	1.02 (0.89-1.17)	0.99 (0.88-1.11)	0.95 (0.80-1.13)	**1.11 (1.03-1.20)**	**1.11 (1.01-1.21)**	**0.08 (0.005 -0.16)**	0.96 (0.89-1.03)	0.96 (0.88-1.04)

Model 1 included the following covariates: age, gender, race-ethnicity, education, health status, BMI, follow-up duration

Model 2 was the same as Model 1, but also included the *baseline* assessment of the respective health behavior

Model 3 employed a multivariable linear regression model instead of logistic regression model. This model evaluated the association of the personality traits on the "change" score in MVPA and diet. In addition to this change score variable, covariates included age, gender, race-ethnicity, education, health status, BMI, follow-up duration.

† For Model 3 for MVPA and Diet, the coefficients are unstandardized beta coefficients as opposed to Odds Ratios

N=Neuroticism, E=Extraversion, O=Openness to Experience, A=Agreeableness, C=Conscientiousness

MVPA, Moderate-to-vigorous physical activity

Bolded cells were statistically significant ($P \leq 0.05$) associations

Table 3A. Multivariable regression models evaluating the association between personality types and multibehavior and behavioral clustering at the 5-month follow-up (N=126).

	Model 1	**Model 2**	**Model 3**
	β (95% CI)	**Odds Ratio (95% CI)**	**Odds Ratio (95% CI)**
	Multibehavior Score at Follow-Up	**High Cluster vs. Low Cluster at Follow-up**	**Energy Balance Cluster vs. Not at Follow-up**
N	-0.02 (-0.07-0.02)	1.06 (0.95-1.20)	1.00 (0.95-1.05)
E	-0.01 (-0.08-0.05)	**1.18 (1.00-1.40)**	1.04 (0.96-1.13)
O	-0.02 (-0.07-0.02)	0.99 (0.87-1.13)	0.97 (0.91-1.03)
A	-0.01 (-0.07-0.05)	0.90 (0.78-1.05)	0.96 (0.89-1.04)
C	0.01 (-0.04-0.07)	1.10 (0.95-1.26)	**1.09 (1.01-1.17)**

N=Neuroticism, E=Extraversion, O=Openness to Experience, A=Agreeableness, C=Conscientiousness

Three multivariate models were computed

The first model (ordinal regression) evaluated the association between personality types and the 5 month follow-up multibehavior index score (range = 0-5) as the outcome variable. Independent variables included the 5 personality types, baseline multibehavior index score, age, gender, race-ethnicity, education, health status, BMI and follow-up duration

The second model (logistic regression) evaluated the association between personality types and high vs. low behavioral clustering. High behavioral clustering was defined as having 4-5 of the health behaviors at follow-up, with low behavioral clustering defined as having 2 or fewer health behaviors at follow-up. Independent variables included the 5 personality types, baseline multibehavior index score, age, gender, race-ethnicity, education, health status, BMI and follow-up duration

The third model (logistic regression) evaluated the association between personality types and energy balance clustering. Energy balance clustering was defined as meeting physical activity guidelines and being in the top median for diet behavior at the follow-up period. Independent variables included the 5 personality types, age, gender, race-ethnicity, education, health status, BMI and follow-up duration.

Bolded cells were statistically significant ($P \leq 0.05$) associations.

Table 4A. Simple linear regression association between personality type and individual health behaviors, with correction for regression dilution bias (N=126).

	β (95% CI)							
	MVPA		**Alcoholic Drinks**		**Diet Score**		**Sleep Duration**	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
N	-6.39 (-14.7,1.93)	-6.94	.08 (-.05,.22)	.08	-.01 (-.06,.04)	-.01	.82 (-.76,2.4)	.89
E	**11.69 (-.36,23.7)**	12.30	**-.21 (-.4,-.01)**	-.22	.06 (-.01,.13)	.06	-.17 (-2.4,2.1)	-.18
O	-2.12 (-12.9,8.6)	-2.27	.05 (-.12,.23)	.05	-.02 (-.09,.04)	-.02	.29 (-1.7,2.3)	.31
A	3.73 (-7.8,15.2)	3.80	**-.27 (-.45,-.08)**	-.28	.02 (-.05,.09)	.02	-.09 (-2.2,2.1)	-.09
C	**15.27 (4.3,26.2)**	15.90	-.04 (-.22,.14)	-.04	**.09 (.02,.16)**	.09	-1.13 (-3.2,.99)	-1.17

Model 1 is the unadjusted model with just the single personality type

Model 2 was the same as Model 1, but corrected for regression dilution bias. Only the corrected regression coefficient is displayed (not the 95% CI)

N=Neuroticism, E=Extraversion, O=Openness to Experience, A=Agreeableness, C=Conscientiousness

MVPA, Moderate-to-vigorous physical activity

Bolded cells were statistically significant (P≤0.05) associations. Statistical significance was only evaluated for Model 1.

Table 1B. Characteristics of the study sample and executive function means (N=126).

Study Variable	Mean/Proportion	Standard Deviation
Age, mean years	21.6	2.3
Gender, % female	61.9	
Education, % undergraduate students	81.0	
Ethnicity, percent non-Hispanic white	66.0	
BMI, mean kg/m^2	25.8	6.9
Health Status		
% excellent	16.6	
% very good	47.6	
% good	30.9	
% fair/poor	4.7	
MVPA at baseline, mean min/week	428.0	353.3
MVPA at 5-month follow-up, mean min/week	571.5	408.5
Follow-up duration, mean days	159.6	24.4
Executive function repeating rule, mean reaction time (ms)	427.3	38.3
Executive function repeating rule, mean percent correct detection	44.4	17.7

BMI body mass index
MVPA, moderate-to-vigorous physical activity

Table 2B. Multivariable linear regression evaluating the association between personality and 5-month follow-up moderate-to-vigorous physical activity (N=126).

Personality Trait	β	95% CI	P-Value
Neuroticism	2.4	-7.2, 12.1	0.61
Extraversion	7.6	-6.4, 21.7	0.28
Openness	-1.5	-12.2, 9.1	0.78
Agreeableness	-4.2	-17.7, 9.3	0.53
Conscientiousness	18.5	5.3, 31.7	**0.006**
Covariates			
Baseline MVPA, 1 min/week increase	0.24	0.02-0.46	0.02
Age, 1 yr increase	-7.6	-48.5, 33.3	0.71
Female vs. male	-103.3	-263.9, 57.1	0.20
Non-white vs. white	-225.2	-384.3, -66.2	0.006
Education, graduate vs. undergraduate	-62.0	-301.0, 176.8	0.60
Health status, good/worse vs. excellent/very good	53.2	-110.3, 216.8	0.52
BMI, 1 kg/m^2 increase	6.2	-7.0, 19.5	0.35
Follow-up period, mean days	1.4	-1.5, 4.3	0.34
Executive function, % correct for repeating rule	2.5	-1.5, 6.7	0.21

A single multivariable linear regression analysis was employed that included the 5 personality traits along with the listed covariates.

BMI, Body mass index
MVPA, Moderate-to-vigorous physical activity
Bolded cells were statistically significant ($P \leq 0.05$) associations

Table 1C. Characteristics of the study sample and TTM construct means (N=126).

Study Variable	Mean/Proportion	Standard
Age, mean years	21.6	2.3
Gender, % female	61.9	
Education, % undergraduate students	81.0	
Ethnicity, % non-Hispanic white	66.0	
BMI, mean kg/m^2	25.8	6.9
Health Status, %		
Excellent	16.6	
Very good	47.6	
Good	30.9	
Fair/poor	4.7	
MVPA at baseline, mean min/week	428.0	353.3
MVPA at 5-month follow-up, mean	571.5	408.5
Follow-up duration, mean days	159.6	24.4
Personality		
Neuroticism, mean	30.9	8.6
Extraversion, mean	43.3	5.9
Openness, mean	39.0	6.7
Agreeableness, mean	45.7	6.3
Consciousness, mean	46.9	6.4
Transtheoretical Model Constructs		
Self-efficacy, mean	66.9	13.1
Pros, mean	22.1	3.0
Cons, mean	8.1	3.1
Cognitive processes of change,	57.4	8.2
Behavioral processes of change,	56.3	9.9
Stage of Change, %		
Maintenance	63.5	
Action	18.3	
Preparation	16.7	
Contemplation	1.6	
Pre-contemplation	0.0	

BMI body mass index

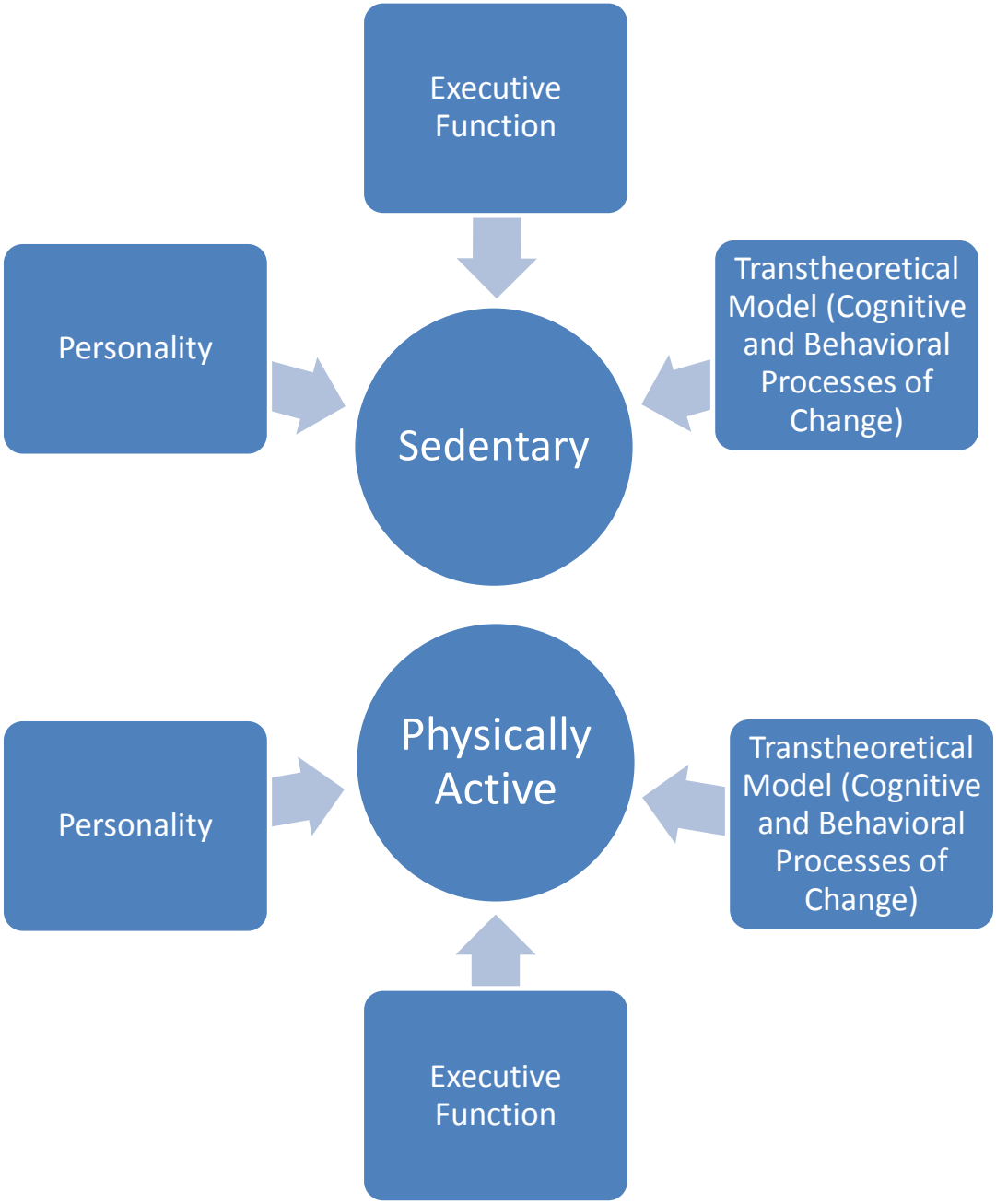
MVPA, moderate-to-vigorous physical activity

Table 2C. Multivariable linear regression evaluating the association between the TTM constructs and 5-month follow-up moderate-to-vigorous physical activity (N=126).

Personality Trait	**β**	**95% CI**	**P-Value**
Cognitive processes of change, 1 unit increase	-1.3	-14.1, 11.1	0.84
Behavioral processes of change, 1 unit increase	10.0	-0.3, 20.3	0.05
Pros, 1 unit increase	-28.6	-64.2, 6.9	0.11
Cons, 1 unit increase	-9.5	-35.1, 16.0	0.45
Self-efficacy, 1 unit increase	2.7	-4.5, 10.0	0.45

A single multivariable linear regression analysis was employed that included the above-noted TTM constructs and the following covariates: baseline MVPA, each of the five personality types, age, gender, race-ethnicity, education, perceived health status (excellent, very good, good, fair, or poor), measured body mass index (kg/m^2) and duration of follow-up (months).

BMI, Body mass index
MVPA, Moderate-to-vigorous physical activity


Executive Function
Personality
Transtheoretical Model (Cognitive and Behavioral Processes of Change)
Sedentary
Physically Active
Personality
Transtheoretical Model (Cognitive and Behavioral Processes of Change)
Executive Function

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RESEARCH INTEREST

Association between personality, physical and mental health behaviors, emotion and cognitive function among college students

Thesis
A Theory-Driven Prospective Approach to Examine the Interrelationships between Personality, Executive Function and Multibehavior

Thesis Advisor: Paul Loprinzi, PhD

RESEARCH PUBLICATIONS

Published Articles

Joyner, C.N. & Loprinzi, P.D. Examining the association of the transtheoretical model constructs on physical activity: considerations of anxiety symptomology as a potential moderator. *Journal of Molecular Pathophysiology* (in press).

Joyner, C.N. & Loprinzi, P.D. The association of personality on anxiety: moderation considerations of physical activity. *Journal of Behavioral Health*.

Loprinzi PD, **Joyner C**. Source and Size of Emotional and Financial-Related Social Support Network on
Physical Activity Behavior Among Older Adults. *J Phys Act Health*. 2016;13(7):776-779.

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